

Low-Voltage 1- Ω SPDT Analog Switch**Features**

- Latch-up Performance Exceeds 600 mA per JESD 78, Class II
- Supply Voltage: 1.65 V to 5.5 V
- Low On-State Resistance: Typical 1 Ω at $V_S = 4.5$ V
- Bandwidth: 100 MHz
- Fast Switching Times: $t_{ON} = 40$ ns, $t_{OFF} = 15$ ns
- Break-Before-Make Switching
- Operation Temperature Range: -40°C to 125°C
- AEC-Q100 Qualified for Automotive Applications, Grade 1: -40°C to 125°C T_A

Applications

- Industry Control Systems
- Battery-Powered Systems
- Audio Signal Routing
- Portable Instruments and Mobile Devices

Description

The device is a high-performance Single Pole/Double Throw (SPDT) analog switch. The device features ultra-low R_{ON} of 2 Ω maximum at 4.5-V V_{CC} and operates over a wide V_{CC} range from 1.65 V to 5.5 V.

The device features a very low quiescent current even when the control voltage is lower than the V_{CC} supply. This feature serves the portable applications very well allowing for the direct interface with processor general-purpose I/Os.

The device has excellent channel-to-channel crosstalk performance to fit applications with high channel-to-channel isolation requirements.

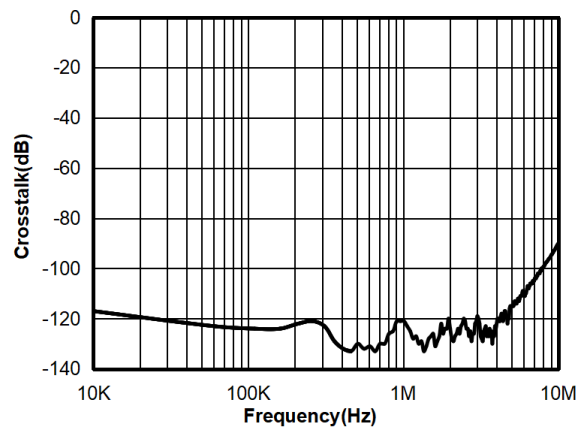


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Revision History

Date	Revision	Notes
2025-07-08	Rev.A.0	Initial Version.
2025-12-08	Rev.A.1	The following updates are all about the new datasheet formats or typos, and the actual product remains unchanged. • Updated the ICC spec in Electrical Characteristics.

Pin Configuration and Functions

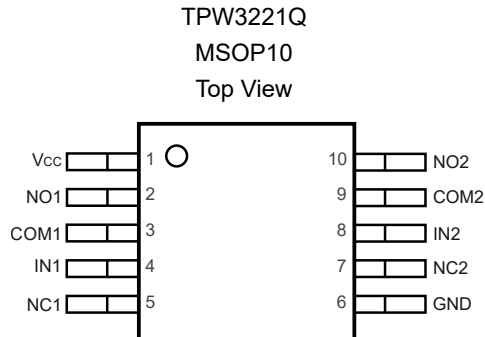


Table 1. Pin Functions

Pin No.	Name	I/O	Description
1	V _{CC}		Power supply
2	NO1	I/O	Switch port 1, normal open
3	COM1	I/O	Common switch port 1
4	IN1	I	Select pin 1
5	NC1	I/O	Switch port 1, normal close
6	GND		Ground
7	NC2	I/O	Switch port 2, normal close
8	IN2	I	Select pin 2
9	COM2	I/O	Common switch port 2
10	NO2	I/O	Switch port 2, normal open

Table 2. Function Table

IN1, IN2	NC1, NC2	NO1, NO2
Low	ON	OFF
High	OFF	ON

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Specifications

Absolute Maximum Ratings ⁽¹⁾

Parameter		Min	Max	Unit
V _{CC}	Supply Voltage, V _{CC}	-0.5	6	V
	Select Input Voltage	-0.5	V _{CC} + 0.5	V
	Select Input Diode Current	-50	50	mA
	Switch I/O Port Voltage	-0.5	V _{CC} + 0.5	V
	Switch I/O Port Diode Current	-50	50	mA
	Switch Current		200	mA
T _J	Maximum Junction Temperature		150	°C
T _{STG}	Storage Temperature Range	-65	150	°C
T _L	Lead Temperature (Soldering, 10 sec)		260	°C

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

ESD, Electrostatic Discharge Protection

Symbol	Parameter	Condition	Minimum Level	Unit
HBM	Human Body Model ESD	AEC Q100-002	±4	kV
CDM	Charged Device Model ESD	AEC Q100-011	±2	kV

Recommended Operating Conditions ⁽¹⁾

All test conditions: over operating temperature range, unless otherwise noted.

Parameter	Min	Max	Unit
Supply Voltage, V _{CC}	1.65	5.5	V
Select Input Voltage	0	V _{CC}	V
Input Transition Rise and Fall Rate		100	ns/V
Switch I/O Port Voltage	0	V _{CC}	V
Operating Temperature Range	-40	125	°C

(1) The select input must be held HIGH or LOW and must not float.

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
MSOP10	150	100	°C/W

Electrical Characteristics

All test conditions: over operating temperature range, typical at $T_A = 25^\circ\text{C}$, $V_{CC} = 4.5\text{ V}$ to 5.5 V , unless otherwise noted.

Symbol	Parameter	Conditions	V _{CC} (V)	Min	Typ	Max	Unit
Power Supply							
I _{CC}	Quiescent Supply Current	V _{IN} = 0 V or V _{CC} , T _A = 25°C	5.5			0.3	μA
		V _{IN} = 0 V or V _{CC}				3	μA
ΔI _{CC}	Increase in I _{CC} per Input	Select Input at 2.7V, others at V _{CC} or GND, T _A = 25°C	4.3			30	μA
		Select Input at 2.7V, others at V _{CC} or GND				35	μA
Digital Input							
V _{IH}	Input Voltage High			2.4			V
V _{IL}	Input Voltage Low					0.8	V
I _{IN}	Control Input Leakage	V _{IN} = 0 V or V _{CC}	5.5	−1		1	μA
Analog Switch							
R _{ON}		I _{OUT} = 100 mA, NCx or NOx = 3.5 V, T _A = 25°C	4.5		1	1.5	Ω
		I _{OUT} = 100 mA, NCx or NOx = 3.5 V				2	Ω
ΔR _{ON}	On Resistance Matching Between Channels	I _{OUT} = 100 mA, NCx or NOx = 3.5 V	4.5		0.12		Ω
R _{FLAT(ON)}	On Resistance Flatness	I _{OUT} = 100 mA, NCx or NOx = 0 V, 1 V, 2 V	4.5		0.3		Ω
I _{NO(OFF)} , I _{NC(OFF)}	Switch OFF Leakage Current on B0, B1	COMx = 0 V, 5.5 V, NCx or NOx = 5.5 V, 0 V, T _A = 25°C	5.5	−0.1		0.1	μA
		COMx = 0 V, 5.5 V, NCx or NOx = 5.5 V, 0 V		−1.5		1.5	μA
I _{A(OFF)}	Switch OFF Leakage Current on A	COMx = 0 V, 5.5 V, NCx or NOx = 5.5 V, 0 V, T _A = 25°C	5.5	−0.1		0.1	μA
		COMx = 0 V, 5.5 V, NCx or NOx = 5.5 V, 0 V		−1.5		1.5	μA
I _{A(ON)}	Switch ON Leakage Current on A	COMx = 0 V, 5.5 V, NCx or NOx = 0 V, 5.5 V or Floating, T _A = 25°C	5.5	−0.1		0.1	μA
		COMx = 0 V, 5.5 V, NCx or NOx = 0 V, 5.5 V or Floating		−1.5		1.5	μA
Dynamic Characteristics							
t _{PHL} , t _{PLH}	Switch IN to OUT Time	NCx or NOx = 3 V, R _L = 50 Ω, C _L = 35 pF, Figure 7	4.5		5		ns

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Symbol	Parameter	Conditions	V _{CC} (V)	Min	Typ	Max	Unit
t _{ON}	Switch Turn-on Time	NCx or NOx = 3 V, R _L = 50 Ω, C _L = 35 pF, T _A = 25°C, Figure 7	4.5			40	ns
		NCx or NOx = 3 V, R _L = 50 Ω, C _L = 35 pF, Figure 7				45	ns
t _{OFF}	Switch Turn-off Time	NCx or NOx = 3 V, R _L = 50 Ω, C _L = 35 pF, T _A = 25°C, Figure 7	4.5			15	ns
		NCx or NOx = 3 V, R _L = 50 Ω, C _L = 35 pF, Figure 7				20	ns
t _B	Break-Before-Make Time	NCx or NOx = 3 V, R _L = 50 Ω, C _L = 35 pF, Figure 8	4.5		20		ns
		NCx or NOx = 3 V, R _L = 50 Ω, C _L = 35 pF, T _A = -40°C to 125°C, Figure 8			40		ns
Q	Charge Injection	C _L = 1.0 nF, V _{GEN} = 0 V, R _{GEN} = 0 Ω, Figure 9	5.5		20		pC
	OFF-Isolation	f = 1 MHz, R _L = 50 Ω, Figure 10	5		-65		dB
	Crosstalk	f = 1 MHz, R _L = 50 Ω, Figure 11	5		-65		dB
	Channel-to-Channel Crosstalk	f = 1 MHz, Figure 12	5		-120		dB
BW	Bandwidth	R _L = 50 Ω	5		100		MHz
THD	Total Harmonic Distortion	R _L = 600 Ω, V _{IN} = 0.5 V _{PP} , f = 20 Hz to 20 kHz	5		0.004		%
Capacitance							
C _{IN}	Select Input Capacitance		5		5		pF
C _{OFF}	B-Port Off Capacitance		5		12		pF
C _{ON}	On Capacitance		5		40		pF

Electrical Characteristics (Continued)

All test conditions: over operating temperature range, typical at $T_A = 25^\circ\text{C}$, $V_{CC} = 2.7\text{ V}$ to 3.6 V , unless otherwise noted.

Symbol	Parameter	Conditions	V _{CC} (V)	Min	Typ	Max	Unit
Power Supply							
I _{CC}	Quiescent Supply Current	V _{IN} = 0 V or V _{CC} , T _A = 25°C	3.6			0.3	μA
		V _{IN} = 0 V or V _{CC}				3	μA
Digital Input							
V _{IH}	Input Voltage High			1.65			V
V _{IL}	Input Voltage Low					0.6	V
I _{IN}	Control Input Leakage	V _{IN} = 0 V or V _{CC}	3.6	−1		1	μA
Analog Switch							
R _{ON}		I _{OUT} = 100 mA, NCx or NOx = 1.5 V, T _A = 25°C	2.7		2	2.5	Ω
		I _{OUT} = 100 mA, NCx or NOx = 1.5 V				3	Ω
ΔR _{ON}	On Resistance Matching Between Channels	I _{OUT} = 100 mA, NCx or NOx = 1.5 V	2.7		0.1		Ω
R _{FLAT(ON)}	On Resistance Flatness	I _{OUT} = 100 mA, NCx or NOx = 0 V, 0.75 V, 1.5 V	2.7		1.2		Ω
I _{NO(OFF)} , I _{NC(OFF)}	Switch OFF Leakage Current on B0, B1	COMx = 0 V, 3.6 V, NCx or NOx = 3.6 V, 0 V, T _A = 25°C	3.6	−0.1		0.1	μA
		COMx = 0 V, 3.6 V, NCx or NOx = 3.6 V, 0 V		−1.5		1.5	μA
I _{A(OFF)}	Switch OFF Leakage Current on A	COMx = 0 V, 3.6 V, NCx or NOx = 3.6 V, 0 V, T _A = 25°C	3.6	−0.1		0.1	μA
		COMx = 0 V, 3.6 V, NCx or NOx = 3.6 V, 0 V		−1.5		1.5	μA
I _{A(ON)}	Switch ON Leakage Current on A	COMx = 0 V, 3.6 V, NCx or NOx = 0 V, 3.6 V or Floating, T _A = 25°C	3.6	−0.1		0.1	μA
		COMx = 0 V, 3.6 V, NCx or NOx = 0 V, 3.6 V or Floating		−1.5		1.5	μA
Dynamic Characteristics							
t _{PHL} , t _{PLH}	Switch IN to OUT Time	NCx or NOx = 1.5 V, R _L = 50 Ω, C _L = 35 pF, Figure 7	2.7		10		ns
t _{ON}	Switch Turn-on Time	NCx or NOx = 1.5 V, R _L = 50 Ω, C _L = 35 pF, T _A = 25°C, Figure 7	2.7			60	ns
		NCx or NOx = 1.5 V, R _L = 50 Ω, C _L = 35 pF, Figure 7				70	ns

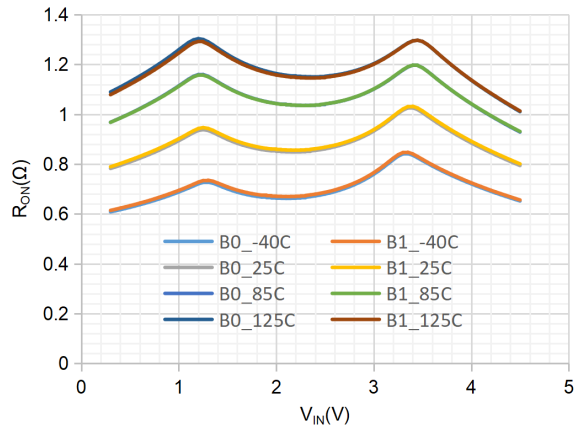
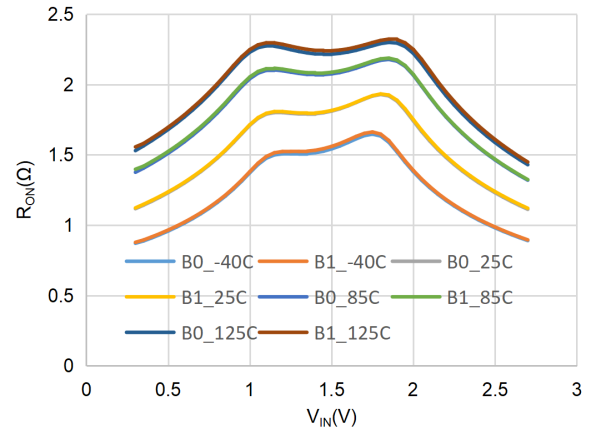
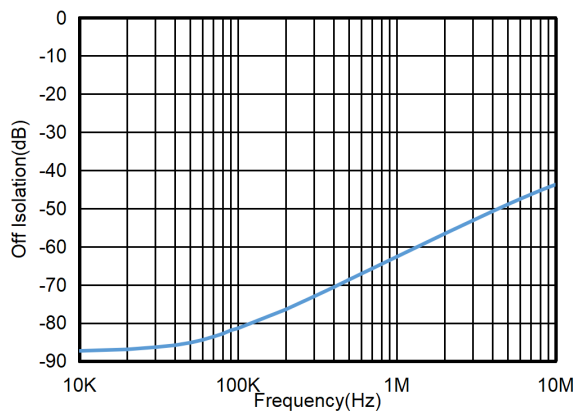
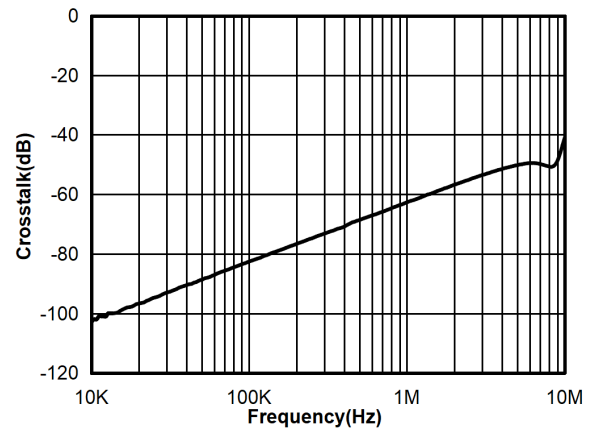
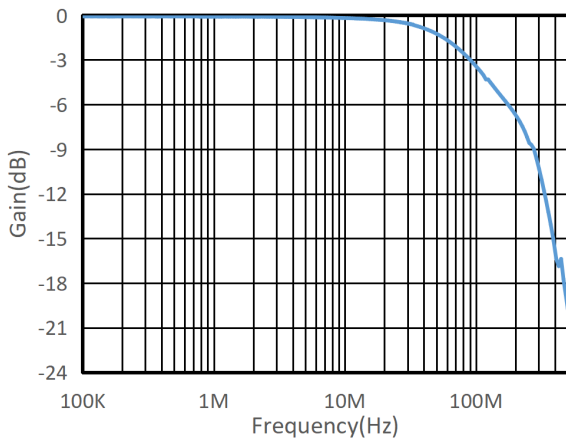
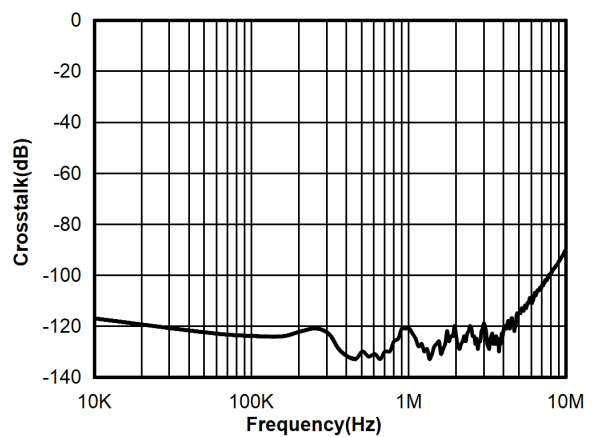
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Symbol	Parameter	Conditions	V _{CC} (V)	Min	Typ	Max	Unit
t _{OFF}	Switch Turn-off Time	NCx or NOx = 1.5 V, R _L = 50 Ω, C _L = 35 pF, T _A = 25°C, Figure 7	2.7			25	ns
		NCx or NOx = 1.5 V, R _L = 50 Ω, C _L = 35 pF, Figure 7				30	ns
t _B	Break-Before-Make Time	NCx or NOx = 1.5 V, R _L = 50 Ω, C _L = 35 pF, Figure 8	2.7		20		ns
Q	Charge Injection	C _L = 1.0 nF, V _{GEN} = 0 V, R _{GEN} = 0 Ω, Figure 9	3		20		pC
	OFF-Isolation	f = 1 MHz, R _L = 50 Ω, Figure 10	3		−65		dB
	Crosstalk	f = 1 MHz, R _L = 50 Ω, Figure 11	3		−65		dB
	Channel-to-Channel Crosstalk	f = 1 MHz, Figure 12	3		−120		dB
BW	Bandwidth	R _L = 50 Ω	3		100		MHz
THD	Total Harmonic Distortion	R _L = 600 Ω, V _{IN} = 0.5 V _{PP} , f = 20 Hz to 20 kHz	3		0.01		%

Electrical Characteristics (Continued)

All test conditions: over operating temperature range, typical at $T_A = 25^\circ\text{C}$, $V_{CC} = 1.65\text{ V}$ to 1.95 V , unless otherwise noted.

Symbol	Parameter	Conditions	V _{CC} (V)	Min	Typ	Max	Unit
Power Supply							
I _{CC}	Quiescent Supply Current	V _{IN} = 0 V or V _{CC} , T _A = 25°C	1.95			0.3	μA
		V _{IN} = 0 V or V _{CC}				3	μA
Digital Input							
V _{IH}	Input Voltage High			1.4			V
V _{IL}	Input Voltage Low					0.4	V
I _{IN}	Control Input Leakage	V _{IN} = 0 V or V _{CC}	1.95	−1		1	μA
Analog Switch							
R _{ON}		I _{OUT} = 10 mA, NCx or NOx = 0.9 V	1.65		10		Ω
ΔR _{ON}	On Resistance Matching Between Channels	I _{OUT} = 10 mA, NCx or NOx = 0.9 V	1.65		0.1		Ω
Dynamic Characteristics							
t _{PHL} , t _{PLH}	Switch IN to OUT time	NCx or NOx = 1.0 V, R _L = 50 Ω, C _L = 35 pF, Figure 7	1.65		10		ns
t _{ON}	Switch Turn-on Time	NCx or NOx = 1.0 V, R _L = 50 Ω, C _L = 35 pF, Figure 7	1.65		80		ns
t _{OFF}	Switch Turn-off Time	NCx or NOx = 1.0 V, R _L = 50 Ω, C _L = 35 pF, Figure 7	1.65		55		ns
t _B	Break-Before-Make Time	NCx or NOx = 1.0 V, R _L = 50 Ω, C _L = 35 pF, Figure 8	1.65		20		ns

Typical Performance Characteristics

Figure 1. R_{ON} , $V_{CC} = 4.5$ V, Temp = $-40, 25, 85, 125^{\circ}\text{C}$

Figure 2. R_{ON} , $V_{CC} = 2.7$ V, Temp = $-40, 25, 85, 125^{\circ}\text{C}$

Figure 3. Off-Isolation, $V_{CC} = 4.5$ V

Figure 4. Crosstalk, $V_{CC} = 4.5$ V

Figure 5. Bandwidth, $V_{CC} = 4.5$ V

Figure 6. Channel-to-Channel Crosstalk, $V_{CC} = 4.5$ V

Test Circuit and Waveforms

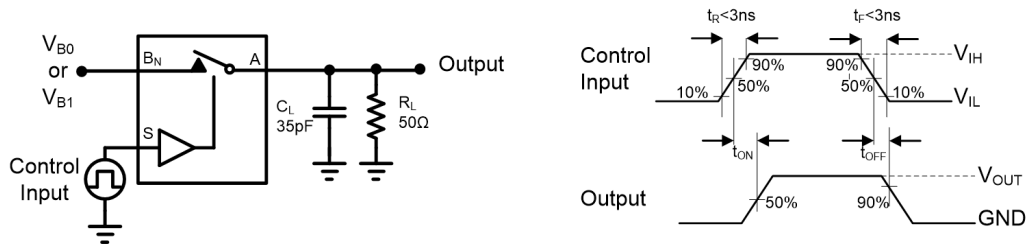


Figure 7. AC Test Circuit and Test Waveforms

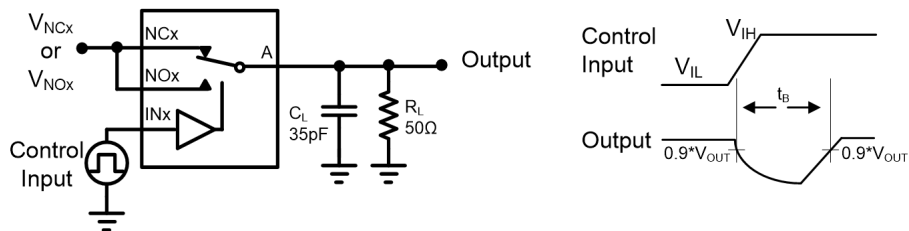


Figure 8. Switch Break Time

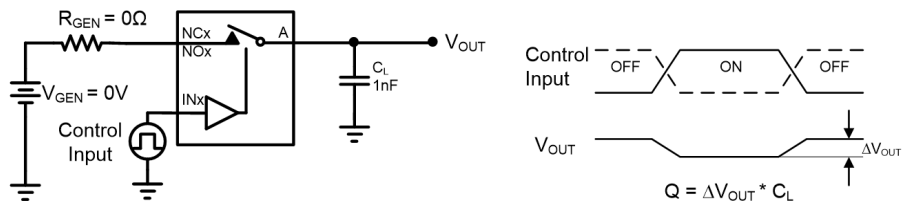


Figure 9. Charge Injection

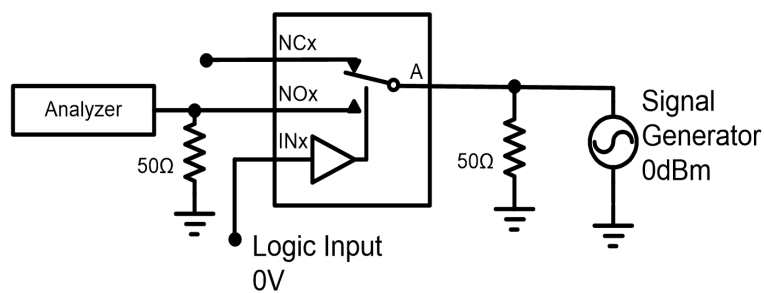


Figure 10. Off Isolation

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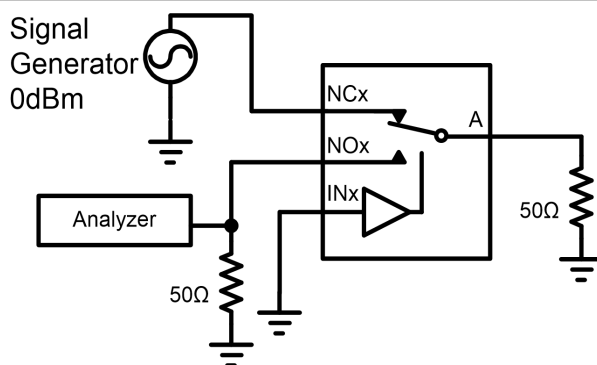


Figure 11. Crosstalk

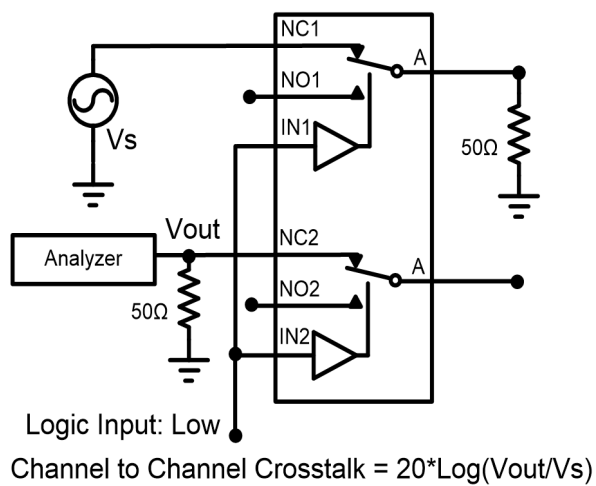


Figure 12. Channel-to-Channel Crosstalk, NC1 to NC2

Application and Implementation

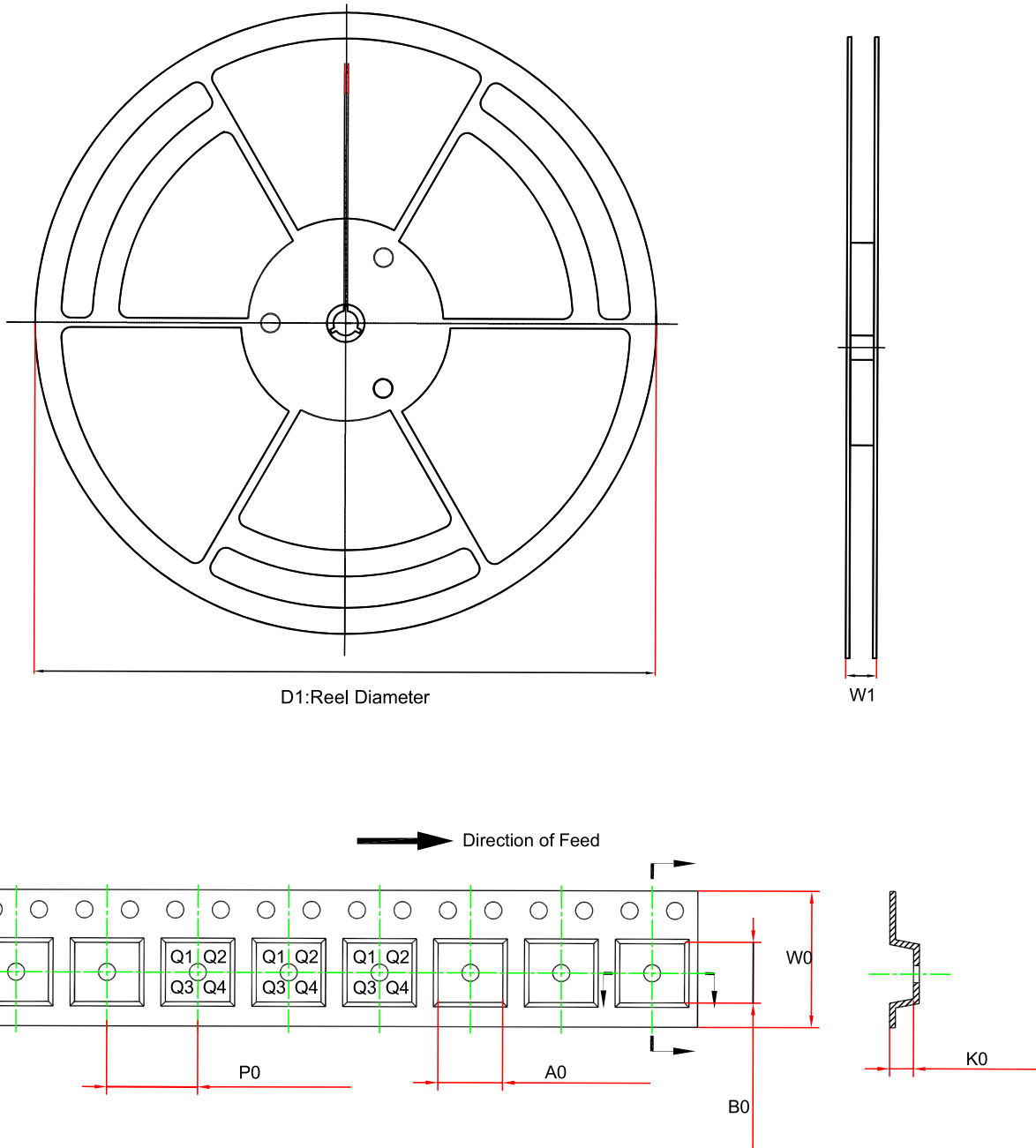
Note

Information in the following application sections is not part of the 3PEAK's component specification and 3PEAK does not warrant its accuracy or completeness. 3PEAK's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

Application Information

A 0.1-μF bypass capacitor on V_{CC} and GND is recommended to prevent power disturbance.

Tape and Reel Information

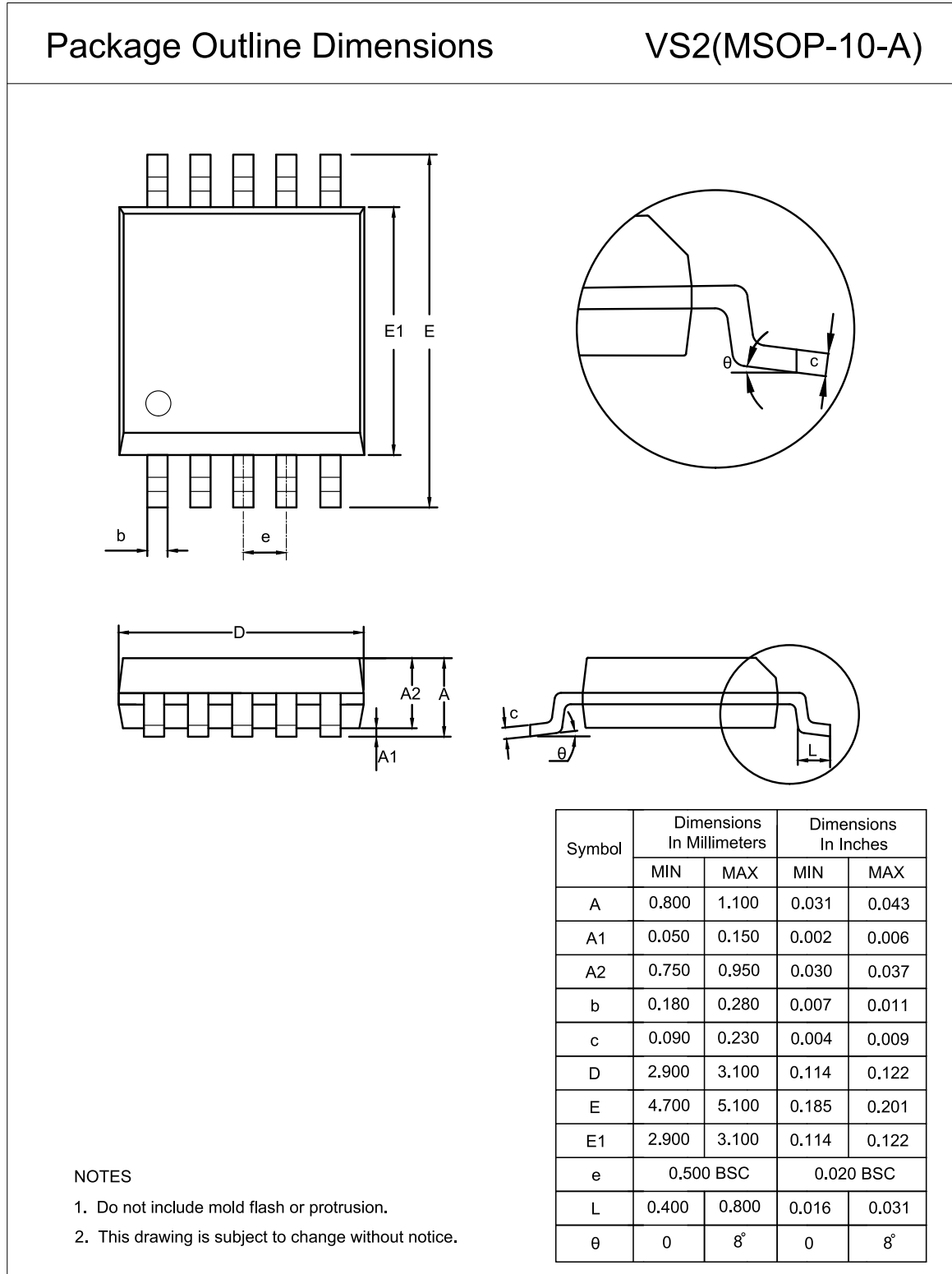


Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm) ⁽¹⁾	B0 (mm) ⁽¹⁾	K0 (mm) ⁽¹⁾	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPW3221Q-VS2R-S	MSOP10	330.0	17.6	5.30	3.40	1.40	8.00	12.00	Q1

(1) The value is for reference only. Contact the 3PEAK factory for more information.

Package Outline Dimensions

MSOP10



Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPW3221Q-VS2R-S	−40 to 125°C	MSOP10	3221Q	3	Tape and Reel,3000	Green

Green: 3PEAK defines "Green" to mean RoHS compatible and free of halogen substances.

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